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(54) Abstract Title

**Monitoring a person using breathing apparatus**

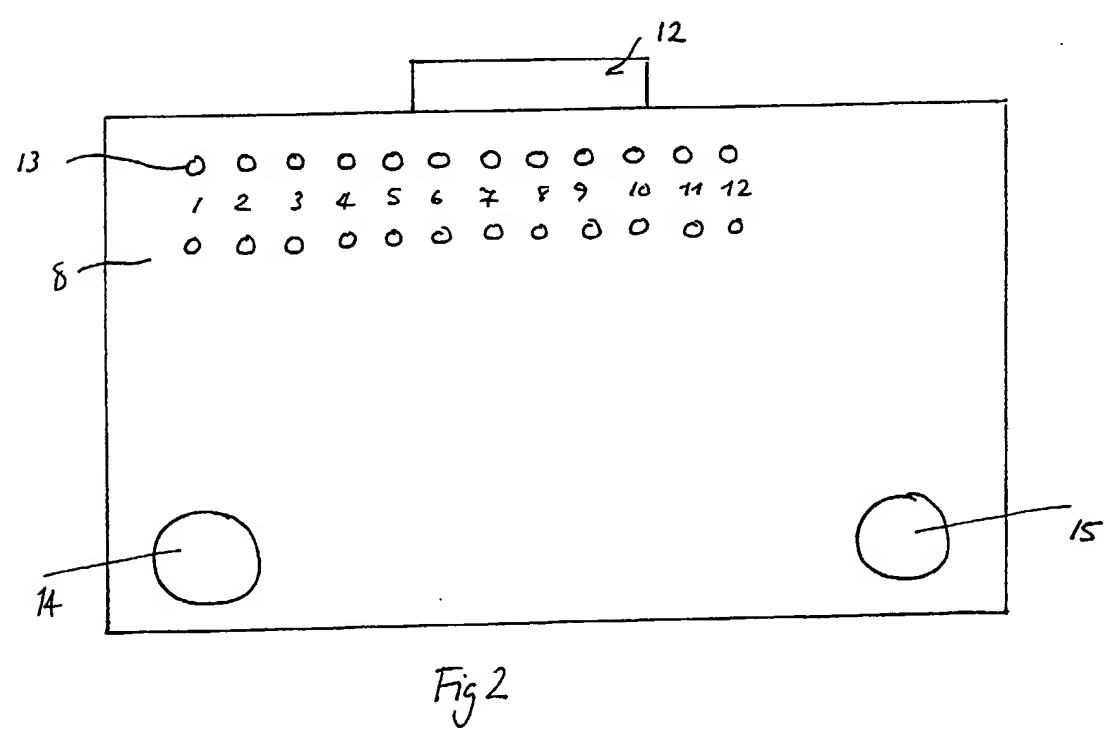
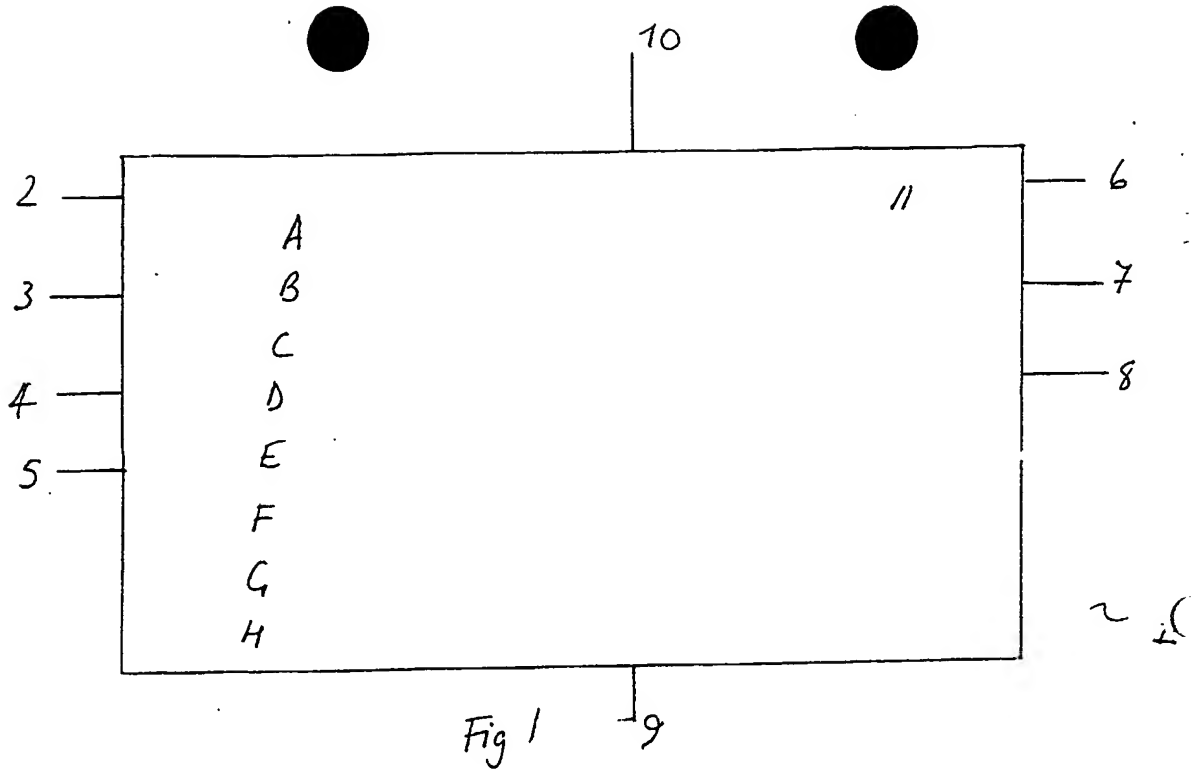
(57) Apparatus for monitoring and control of persons using breathing apparatus is of particular use in the monitoring and control of fire fighters on duty in a hazardous area, such as a smoke filled building.

The control apparatus comprises a programmable visual display monitor adapted to receive, assimilate and display information relating to the condition of users of breathing apparatus recorded by remote sensors, which are normally positioned in association with breathing apparatus.

The control apparatus further comprises a pager to allow delivery of an alert to all fire fighters to leave a dangerous area.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995



1     Control Apparatus and Method

2

3     The invention relates to a control apparatus, and in  
4     particular to a control apparatus for monitoring and  
5     directing persons in hostile environments, and a  
6     method of directing and monitoring the behaviour of  
7     such persons. A suitable use for the invention  
8     would be the monitoring and directing of fire  
9     fighters in a hostile environment such as a burning  
10    building. A further use would be monitoring any use  
11    of breathing apparatus.

12

13    To enter and work in hostile environments such as  
14    areas filled with smoke or toxic fumes, fire  
15    fighters need to use portable breathing apparatus to  
16    enable them to breathe. When breathing apparatus  
17    for this purpose was developed in the last quarter  
18    of the nineteenth century, it became apparent that  
19    it is necessary to monitor closely the use of such  
20    apparatus, for example to determine when the air  
21    supply is nearing exhaustion.

22

1 The apparatus for and method of monitoring developed  
2 was a "Breathing Apparatus Entry Control Board" or  
3 'tally' board. This is a board carried in fire  
4 fighters' vehicles, which is adapted to be situated  
5 at the designated point of entry to a hazardous  
6 environment such as a burning building.

7  
8 The tally board is a reusable writing surface on  
9 which one designated person only - the Entry Control  
10 Officer (ECO) - is authorised to write information,  
11 and which he uses to record the event of entry of a  
12 fire fighter into a hazardous environment, the time  
13 of their entry, and the amount of air or gas in  
14 their breathing apparatus at that time.

15  
16 Tally boards are still used today to record the  
17 vital information of each fire fighter entering a  
18 hazardous environment. It is however apparent that  
19 it would be advantageous to have the capacity to  
20 monitor a number of parameters indicative of each  
21 fire fighter's circumstances and provide each fire  
22 fighter with adequate warning of, for example,  
23 depleted resources, to enable them to exit the  
24 hostile environment in a timely manner. It is  
25 equally advantageous to provide means to supply  
26 those outside the hostile environment with  
27 sufficient information to recognise a fire fighter's  
28 inability to leave the environment due, for example,  
29 to loss of consciousness, to allow steps to be taken  
30 to rectify the situation. Failure to leave the  
31 hostile environment before exhaustion of vital

1 resources, such as air, may have disastrous  
2 consequences for a fire fighter.

3

4 At present, an ECO is assigned to monitor a specific  
5 group of fire fighters required to enter a hostile  
6 environment such as a burning building. It is the  
7 ECO's additional responsibility to direct the  
8 operations of the members of his group, and to co-  
9 ordinate with other such groups. On arrival at the  
10 hazardous environment the ECO sets up the static  
11 tally board at the designated point of entry to the  
12 environment and records the identity of each fire  
13 fighter in his group and their time of entry into  
14 the environment.

15

16 This apparatus and method of control of fire  
17 fighters has numerous drawbacks. For example, each  
18 ECO can track only a group comprising a limited  
19 number of fire fighters, and the ECO receives no  
20 useful feedback on the progress or condition of the  
21 fire fighters in his group.

22

23 Thus, the purpose of this invention is to replace  
24 the inflexible and limited system currently in use  
25 to monitor the entry of fire fighters to hazardous  
26 environments with apparatus adapted to monitor the  
27 progress of each fire fighter individually, and to  
28 monitor and record his vital data.

29

30 Currently, the only way of communicating with a fire  
31 fighter in a hazardous situation is by means of hand

1 held two way radio. Such radios are of no use if a  
2 fire fighter is injured or unconscious.

3

4 A further purpose of the invention is to provide  
5 reliable means for delivering unambiguous commands  
6 to a fire fighter in a hazardous situation

7

8 According to the present invention there is provided  
9 a control apparatus for monitoring and directing at  
10 least one person using breathing apparatus  
11 comprising indication means; and communication  
12 means.

13

14 Preferably said control apparatus is adapted to  
15 receive signals from and/or send signals to a remote  
16 apparatus associated with said person. More  
17 preferably said control apparatus is adapted to  
18 communicate with said remote apparatus by means of  
19 telemetry.

20

21 Said control apparatus may comprise at least one  
22 encoder, and preferably a plurality of encoders.  
23 Said encoder may be adapted to generate a telemetry  
24 identification (ID) numbers.

25

26 Preferably said control apparatus comprises a  
27 programmable visual display unit. Typically said  
28 control apparatus comprises data recording means.  
29 Said control apparatus may comprise paging means.  
30 Said control apparatus may comprise computational  
31 means.

32

1 Preferably said control apparatus is adapted to co-  
2 operate with a remote apparatus in the form of a  
3 monitoring unit and/or distress signal unit.

4

5 Said remote apparatus is preferably portable. Said  
6 remote apparatus may comprise a monitoring unit  
7 and/or a distress signal unit. Said remote apparatus  
8 may comprise computational means.

9

10 Typically said remote apparatus is adapted to be  
11 associated with at least one sensor. Said remote  
12 apparatus may be adapted to be associated with a  
13 plurality of sensors. Said sensors may include  
14 respiration and/or pressure and/or temperature  
15 and/or demand valve sensors.

16

17 Said remote apparatus may comprise an alarm.  
18 Preferably said remote apparatus comprises a  
19 plurality of alarms.

20

21 Said remote apparatus may comprise a respiratory  
22 monitor comprising an air measurement device, a  
23 conversion device for converting measurements of the  
24 air into a signal relating to the remaining  
25 respiratory time and an output device for providing  
26 an output relating to the remaining respiration  
27 time.

28

29 Said respiratory monitor may provide an alarm when  
30 the monitored rate of air usage falls below a given  
31 predetermined rate for a predetermined period.

32

1 Said remote apparatus may comprise homing means.

2

3 Preferably said control apparatus is adapted to  
4 communicate with said remote apparatus by means of  
5 telemetry. More preferably said control apparatus is  
6 adapted to receive signals from and/or to transmit  
7 signals to said remote apparatus.

8

9 According to a further aspect of the present  
10 invention there is provided A method of monitoring  
11 the use of breathing apparatus comprising the steps  
12 of generating a job-specific ID number; allocating  
13 the ID number to an individual; collecting data  
14 relating to the well-being of the individual;  
15 assimilating the data; and noting whether action is  
16 required.

17

18 Embodiments of the present invention will now be  
19 described by way of example only and with reference  
20 to the drawings in which:

21

22 Fig 1 is a schematic drawing of a control apparatus  
23 of an embodiment of the present invention; and

24

25 Fig 2 is a schematic drawing of a control apparatus  
26 of an embodiment of the present invention.

27

28 Referring to the Figures, a control apparatus for  
29 monitoring use of breathing apparatus, and  
30 particularly for monitoring and directing fire  
31 fighters in a hazardous environment comprises a  
32 control apparatus in the form of a programmable



1 visual display unit 11. The control apparatus 1 is  
2 adapted to receive information from remote  
3 apparatus, which is normally positioned in  
4 association with breathing apparatus.  
5

6 The control apparatus 1 comprises a microprocessor  
7 and a board with a visual display 11, which can, for  
8 example, show information at positions A to H, which  
9 can be allocated to convey, for example:

- 10 A ID Indicators
- 11 B ID Sensors
- 12 C Manual Alarm
- 13 D Victim Located Alarm
- 14 E Radio Link Failure Alarm
- 15 F Water On
- 16 G Water Off
- 17 H Back Up Required

18

19 The control apparatus 1 further comprises one or  
20 more ID transmitters 2, telemetry radios 3, paging  
21 transmitter 4, telemetry decoders 5, data recorder  
22 6, audio/visual alarms 7, key sockets 8, means to  
23 include the control apparatus in a network of  
24 similar control apparatus 9, and digital clocks 10.

25

26 As shown in Fig 2, the board can comprise a number  
27 of ports, each accompanied by a light 13 and a key  
28 socket 8. The board further comprises a siren 12,  
29 an evacuation pager 14, and an emergency siren  
30 button 15.

31

1 The control apparatus 1 is of robust construction.  
2 It is drop proof, and totally sealed to prevent  
3 water penetration. It is adapted to be powered by  
4 heavy duty rechargeable batteries, or removable dry  
5 batteries. Suitable rechargeable batteries are  
6 normally stored in fire fighters' vehicles, kept on  
7 trickle charge.

8  
9 The remote apparatus comprises a portable monitoring  
10 unit and/or distress signalling unit adapted for  
11 wear by or in association with each person to be  
12 monitored and controlled.

13  
14 Breathing apparatus worn by individual fire  
15 fighters, normally in conjunction with a face mask,  
16 comprises an air cylinder and a face mask inlet for  
17 providing air to provide air to the face mask. The  
18 air cylinder is portable, and the breathing  
19 apparatus is adapted to be worn by a user to allow  
20 movement and work in a hostile environment. The  
21 breathing apparatus also comprises a portable unit  
22 in the form of a personal monitor, which also  
23 functions as a distress signal unit, which can be  
24 calibrated to alert a fire fighter when it is 'time  
25 to leave' the hazardous area, for example in a  
26 situation when his air is low or, if he is in  
27 distress, to alert others in the vicinity to a  
28 colleague's need for assistance.

29  
30 In some embodiments the breathing apparatus  
31 comprises a pressure transducer to allow measurement  
32 of the air pressure in the cylinder at any time.

1 For example, when the pressure is measured to have  
2 reached a base level representing the beginning of  
3 an emergency reservoir of air a signal triggers an  
4 alarm.

5  
6 In some embodiments the apparatus comprises a  
7 pressure drop detector to allow measurement of the  
8 pressure drop between the time at which respiration  
9 using the breathing apparatus begins, and the time  
10 at which work starts - which may indicated manually  
11 by a user. A calculating unit, either associated  
12 with the breathing apparatus or in the control  
13 apparatus, can be employed to calculate when the  
14 pressure in the air cylinder is equal to the  
15 magnitude of the pressure drop plus the base level  
16 and trigger an alarm to alert a fire fighter that it  
17 is 'time to leave' the hazardous area.

18  
19 The information gathered by the portable unit, which  
20 information defines the condition of its user, is  
21 invaluable when relayed outside the hazardous area  
22 for remote monitoring by the control apparatus. In  
23 normal use, a signal transmitted from the portable  
24 unit to the control apparatus allows the COE to  
25 monitor the position of each fire fighter, thus  
26 assisting in their location for rescue or to  
27 identify the closest person to assist in an  
28 emergency.

29  
30 The control apparatus 1 is configured to receive,  
31 assimilate and display information relating to  
32 specific fire fighters in a hazardous zone, and to

1 provide a means of communication with the fire  
2 fighters. The apparatus is configured to receive  
3 information from a plurality of radio  
4 transmitter/receivers or sensors adapted for  
5 attachment to, inclusion in, or association with the  
6 breathing apparatus of each fire fighter.

7  
8 Of further advantage is the ability to communicate  
9 with each fire fighter from outside the hazardous  
10 area via the portable unit, by sending a signal from  
11 the control apparatus to one or more portable units.

12  
13 Each control apparatus 1 is designed to monitor a  
14 given number of fire fighters. In this embodiment  
15 each apparatus is configured to monitor twelve fire  
16 fighters.

17  
18 This invention utilises the unique concept of  
19 providing each fire fighter with a job specific ID  
20 (ID) number just prior to their entry to a hazardous  
21 area.

22  
23 The control apparatus comprises a programmable  
24 visual display 11 including twelve encoders and  
25 twelve decoders. In the embodiments of Fig 1 and Fig  
26 2 the visual display is in the form of an LCD  
27 display screen and/or simple indicator lights. The  
28 display can alternatively be another form of visual  
29 display, and can include audible signal means.

30  
31 Each apparatus is adapted to generate a set of ID  
32 numbers, and no two apparatus generate duplicate ID

1 numbers. This allows a plurality of apparatus to be  
2 used simultaneously, or as a network, without  
3 interference, and a single ECO to monitor a large  
4 number of fire fighters.

5  
6 The encoders are adapted to generate job specific  
7 identity numbers for each individual prior to their  
8 entry to a hazardous zone, and to communicate his  
9 identity number for this specific job to the  
10 individual in the way explained below. From the  
11 time the identity number is generated, each  
12 individual is continuously monitored by the control  
13 apparatus over a radio telemetry link.

14  
15 The control apparatus further comprises a telemetry  
16 radio 3, adapted to detect all data transmitted from  
17 personal monitoring units of fire-fighters whose ID  
18 numbers have been generated by this particular  
19 control apparatus, and a telemetry decoder 5 to  
20 convert incoming radio telemetry signals into  
21 meaningful visual displays.

22  
23 The person is therefore a remote source of data  
24 which is measured and then transmitted by radio or  
25 other means to the control apparatus 1, for  
26 recording and analysis.

27  
28 In this way the controller is alerted substantially  
29 instantaneously by the control apparatus to the  
30 occurrence of a distress situation.

31

1 Each control apparatus 1 generates a unique set of  
2 ID numbers, and responds only to its own set of  
3 numbers. This allows a large number of these  
4 control apparatus to operate at a very large  
5 incident, without interfering with each other. Each  
6 control unit 1 has a method of transmitting the  
7 unique number generated for him to a particular fire  
8 fighter, for example over a radio, infra red or  
9 other type of remote link. The control apparatus  
10 can then instantly identify each fire fighter by  
11 this unique number. (

12  
13 The nature of fire fighting is such that, for safety  
14 reasons, it is important that there is a national  
15 standard for operations. For this reason each fire  
16 fighter is generally equipped with the same standard  
17 portable unit. The nature of this invention is such  
18 that, since each portable unit is allocated a job  
19 specific ID number by the control apparatus, it  
20 enables any portable unit to operate in conjunction  
21 with any control apparatus in the UK, or other  
22 jurisdiction operating to the same standards. (

23 Although no two operational control apparatus  
24 generate the same digital ID code numbers, each  
25 portable unit is adapted to accept every ID code  
26 from any operational control apparatus.

27  
28 The control apparatus and the portable units are  
29 adapted to co-operate by means of a 'key' system.

30  
31 The 'key' is a removable means associated with the  
32 personal monitoring unit or alarm, which is adapted

1 to switch the unit on and off. The purpose of the  
2 key is to allow the fire fighter to switch on his  
3 unit and also to disable the alarm if, for example,  
4 it is triggered accidentally. However, it is  
5 undesirable that a fire fighter can decide  
6 unilaterally to disengage his personal alarm while  
7 on duty in a hazardous area. The key must therefore  
8 be removed from the alarm prior to entering the  
9 hazardous zone. Each control apparatus has a  
10 display board 11 with a plurality of positions. In  
11 the embodiment described, the board has twelve  
12 different positions, each of which has a key socket  
13 8. Each socket 8 is adjacent a display, and each  
14 position is provided with an encoder and a decoder.  
15 All the decoders on the board are on the same  
16 channel. In use, when a monitoring unit is switched  
17 on, the key is removed from unit and placed in a  
18 socket 8 on the board 11. When a key is removed  
19 from a personal alarm and placed in an appropriate  
20 socket 8 and switched on, the encoder associated  
21 with that position allocates an ID number to that  
22 portable unit, and a digital transmitter sends that  
23 encoded signal to the unit from which the key was  
24 removed, by radio, wire or other link. The encoded  
25 signal is specific to this user for this use only.  
26 This signal 'primes' a unit by allocating it a  
27 unique identification code for a job, and the  
28 control apparatus identifies the unit by that code.  
29 Once the ID number is received by the portable unit  
30 it is locked in and cannot be overwritten until the  
31 key is replaced in the portable unit, and the unit  
32 is switched off.

1  
2 In this way, the ID number is associated with the  
3 portable unit from which the key was removed. Each  
4 key is labelled with personal data of each  
5 individual fire fighter, including their name, the  
6 amount of remaining air in their cylinder and their  
7 tally number, and any information relevant to that  
8 fire fighter which is transmitted to the board  
9 together with the ID number, is displayed at that  
10 position on the board.

11  
12 Adjacent each key port on the control board is an  
13 indicator light 13. In this embodiment, when a key  
14 is placed in the socket 8 and switched on, a green  
15 light lights. The instant the data monitored by an  
16 sensor or sensors in the portable unit associated  
17 with that particular position indicates that a  
18 particular fire fighter is in distress, a red light  
19 replaces the green light at that position. This  
20 ensures instant identification of the individual in  
21 distress.

22  
23 That is, the portable unit comprises a plurality of  
24 sensors, and an alarm circuit. The alarm circuit is  
25 triggered when the portable unit senses that the  
26 fire fighter is in distress. In this situation, the  
27 transmitter sends the encoded signal (the ID number)  
28 to the receiving station, sometimes in combination  
29 with a further signal comprising data.

30  
31 Encoded signals from each fire fighter controlled by  
32 a particular board are all sent on the same channel.



1 All the decoders on the board receive the signal.  
2 However, each decoder recognises only one particular  
3 signal, the one generated at its port. Thus only  
4 the relevant decoder responds to the encoded signal,  
5 and a red light shows at the relevant port,  
6 immediately identifying the distressed party.

7  
8 Each portable unit optionally includes a motion  
9 sensor. The motion sensor is adapted such that the  
10 absence of movement for a period of twenty seconds  
11 triggers a primary audio signal, and the continued  
12 absence of movement for a further 10 seconds  
13 triggers a second, more powerful audio signal  
14 together with automatic transmission to the control  
15 apparatus of a radio signal that comprises the ID  
16 number. On receipt of this second signal the  
17 control apparatus activates a siren to alert the ECO  
18 of a possible distress situation, simultaneously  
19 identifying the source of the distress.

20  
21 The portable unit optionally includes any  
22 combination of a plurality of sensors, such as  
23 respiratory function sensors, temperature sensors,  
24 heart rate monitors and the like. The information  
25 detected by these sensors is transmitted over the  
26 radio telemetry link to the receiving station  
27 together with the ID number and is both available to  
28 the ECO at any given instant, and recorded for  
29 future analysis. The portable unit, in some  
30 embodiments, also includes computational means to  
31 analyse or partially analyse the information  
32 detected. Additionally or alternatively the

1 information detected can be analysed or partially  
2 analysed by the control apparatus.

3

4 Each position on the board is accompanied by a clock  
5 display 10 which notes the time of entry of the fire  
6 fighter allocated that ID number to the controlled  
7 zone, and indicates a suggested time to leave.

8

9 The apparatus is also configured to monitor the air  
10 pressure in the breathing apparatus air or gas  
11 storage cylinder of the person allocated that ID  
12 number, and to provide an instant calculation of  
13 approximate time they have available to operate in  
14 thick smoke, with a pre-set 'time to leave' alarm.

15

16 In an alarm mode the alarm circuit powers the  
17 emergency signal, which powers the encoder. In this  
18 way the alarm circuit in the portable apparatus  
19 sends this encoded signal to the control apparatus.  
20 In the control apparatus, the decoder associated  
21 with this ID number identifies the signal, and a red  
22 light shows at the relevant position on the board.

23

24 Thus, when any fire fighter being monitored is in a  
25 distress situation their monitoring/distress signal  
26 unit transmits their unique ID number to the control  
27 apparatus, which displays a visual signal, thus  
28 instantly alerting the ECO to a problem, and  
29 identifying the fire fighter in distress. In an  
30 embodiment of the invention receipt of an alarm  
31 signal triggers the control apparatus instantly and  
32 automatically to alert a rescue team.

1  
2 The monitoring and analysis of information received  
3 by the control apparatus from the sensors over a  
4 radio telemetry link gives the CEO a clear picture  
5 of the condition of all of the men under his  
6 control. Some examples of uses of the apparatus  
7 are:

8  
9 Evaluating respiratory function. This allows  
10 instant identification of respiratory malfunction of  
11 any user, which triggers an alarm.

12  
13 Continuous updating of ongoing drop in cylinder  
14 pressure of each user's breathing apparatus. This  
15 allows the control unit to compute when where is  
16 just sufficient air to enable a fire fighter to  
17 return to entry control, and triggers an alarm.

18  
19 Monitoring air pressure drop over a short pre-set  
20 time intervals. This means that when the drop is  
21 greater than a pre-set level, for example due to the  
22 face mask demand valve remaining open at the end of  
23 a respiratory cycle, this will trigger an alarm

24  
25 Monitoring internal temperature of a user's face  
26 mask. Excessive temperatures trigger an alarm.

27  
28 Indication of activation by a user at their unit of  
29 a manually activated alarm. This causes their ID  
30 number to be displayed on the board, and triggers an  
31 alarm.

32

- 1 Monitoring user's body temperature. Excessive
- 2 temperatures trigger an alarm.
- 3
- 4 Monitoring respiration. This allows instant
- 5 notification of other team members if respiratory
- 6 failure occurs.
- 7
- 8 Communication with control. This allows
- 9 notification as soon as a victim is located.
- 10
- 11 Identifying location of each team is operation. (
- 12
- 13 Monitoring ongoing reduction in gas pressure in
- 14 cylinders.
- 15
- 16 Monitoring heart rate or any other biological
- 17 functions. This provides instant notification that
- 18 a fire fighter is hyperventilating.
- 19
- 20 Identification of sensor failure.
- 21
- 22 Data recording capability for future research, (
- 23 evaluation, and as evidence for inquiries. That is,
- 24 the control apparatus also has provision for ongoing
- 25 monitoring of the sensors on the portable units
- 26 including sensors recording respiration, face and
- 27 body temperature, face mask pressure, other
- 28 biological functions, and the breathing apparatus
- 29 demand valve monitor.
- 30
- 31 This data can be collected, for example on floppy
- 32 disk, for future analysis of biological behaviour of

1 persons operating in these types of hostile  
2 environment; or for use by, for example, designers  
3 of face masks.

4  
5 Integrated communication system including a paging  
6 evacuation signal to permit the CEO to withdraw  
7 individuals or teams.

8  
9 That is, the apparatus further comprises a  
10 communication facility in the form of a paging  
11 transmitter designed for use as an evacuation system  
12 for instant recall of all deployed fire fighters.  
13 The transmitter is operable to produce a signal.  
14 The signal can optionally be sent to a particular  
15 individual or individuals, or everyone in the group  
16 controlled by a specific apparatus to order their  
17 evacuation from the hazardous zone.

18  
19 Pager operation means is situated on the control  
20 board. When activated, the pager triggers a remote  
21 signal in the face masks of some or all of the users  
22 identified by the control apparatus, as appropriate.  
23 To order evacuation of an area, the ECO need only  
24 operate the pager. Each face mask is adapted to  
25 display the evacuation signal as a bright light.  
26 The use of stark visual signals excludes the  
27 possibility of ambiguity of verbal commands over  
28 two-way radio, the current means of communication.

29  
30 Each portable unit is equipped with a homing beacon,  
31 and a face mask adapted for use with the breathing  
32 apparatus comprising the portable apparatus is

1 adapted to contain a range limited receiver  
2 connected to a warning light suitably situated in a  
3 wearer's field of vision. When activated, for  
4 example by the operation of a motion or respiratory  
5 sensor alarm, the homing beacon is adapted to  
6 activate warning lights in the face masks of others  
7 already within the range of the beacon such as  
8 nearby fire fighters, and also to activate warning  
9 lights in the face masks of rescuers when they enter  
10 the range of the beacon, to indicate that they are  
11 in the vicinity of the distressed. (

12

13 In the specific example shown in Fig 1, indication  
14 positions are identified as A-H, and are allocated  
15 to provide specific information to the controller,  
16 in the form of an easily read visual display.

17

18 Messages sent voluntarily or involuntarily over the  
19 telemetry link between control apparatus and remote  
20 units are immediately and reliably received and can  
21 be acted upon instantaneously.

22

23 Information relating to each monitored fire  
24 fighter's progress is sensed by the sensors in his  
25 portable unit, and relayed to the control apparatus  
26 where it is displayed visually. The information  
27 collated is displayed in relation to each fire  
28 fighter's programmed ID number, so it is immediately  
29 apparent to whom the information displayed refers.  
30 The information can also be recorded for future  
31 reference.

32

1 When a fire fighter's sensors indicate that there is  
2 an alarm situation, for whatever reason, the alarm  
3 circuit powers an encoder, which sends a signal back  
4 to the decoders in the control apparatus. All the  
5 decoders in the apparatus receive the signal, but  
6 only respond to a signal they identify. That is,  
7 when a distress signal is received it is recognised  
8 by its individual ID number generated by the board,  
9 and triggers a visual signal on the display at the  
10 relevant port, indicating the identity of the  
11 distressed individual.

12  
13 The control apparatus can be configured to display a  
14 number of parameters, conditions or situations.  
15 Different lights or other indicators associated with  
16 each position can indicate a pre-arranged message.

17  
18 Some examples of this are, as shown in Fig 1:

19  
20 The display can be configured to indicate when  
21 manual alarm has been activated by an individual  
22 operating in the hazardous area, and to indicate  
23 their identity, since the ID number is automatically  
24 sent together with the alarm signal.

25  
26 The display can be configured with a visual signal  
27 designated to communicate the messages "victim  
28 found" or "assistance required", and to indicate the  
29 identity of the message sender, since the ID number  
30 is automatically sent together with the signal, and  
31 appears at a particular port.

32

1 The display can be configured to indicate a  
2 breakdown in the radio telemetry link.

3

4 The display can be configured with a visual signal  
5 designated to communicate the message "turn on water  
6 at pump", and to indicate the identity of the  
7 message sender, since the ID number is automatically  
8 sent together with the signal, and appears at a  
9 particular port.

10

11 The display can be configured with a visual signal  
12 designated to communicate the message "turn off  
13 water at pump", and to indicate the identity of the  
14 message sender, since the ID number is automatically  
15 sent together with the signal, and appears at a  
16 particular port.

17

18 The display can be configured with a visual signal  
19 designated to communicate the message "back-up  
20 required", and to indicate the identity of the  
21 message sender, since the ID number is automatically  
22 sent together with the signal, and appears at a  
23 particular port.

24

25

26 Each control apparatus is provide with means to  
27 include the apparatus in a network of control  
28 apparatus comprising a plurality of control  
29 apparatus in use at a particular the incident. When  
30 the control apparatus are networked, this enables an  
31 overall command to co-ordinate all entry control  
32 points.



1  
2 An important feature of the invention is that,  
3 unlike the static board it has been designed to  
4 replace, it is possible to update all recorded data,  
5 including all data transmitted from each fire  
6 fighter's personal monitor - which also functions as  
7 their automatic distress signal unit, over a radio  
8 telemetry link and instantly display the information  
9 on the control unit display panel.

10  
11 Furthermore, unlike present practice, which requires  
12 the controller to write on the static board to  
13 record the time each fire-fighter passes through the  
14 entry point, and the amount of air or gas in each of  
15 their respective storage cylinders. The ongoing  
16 drop in pressure of each breathing apparatus  
17 cylinder is displayed on the visual display, and can  
18 be monitored, and the apparatus computes when it is  
19 'time to leave', and activates an alarm alerting  
20 both the fire fighter and the controller that the  
21 fire fighter must leave the hazardous area.

22  
23 The apparatus also monitors each fire fighter's face  
24 temperature, body temperature, heart rate monitoring  
25 and respiration. A respiratory monitor in the  
26 breathing apparatus constantly monitors respiration,  
27 and indicates when this is normal, but has an alarm  
28 function alerting the onset of hyperventilation, or  
29 unconsciousness resulting in altered respiratory  
30 function. A suitable respiratory monitor is  
31 described in UK Patent No 2311015.

32

1 Monitoring radio telemetry signals from portable  
2 radio biological monitors including motion sensing  
3 based units and biological monitors enables the ECO  
4 to be alerted the instant any fire fighter is in any  
5 type of distress, including becoming trapped or  
6 unconscious, or encounters any biological problem  
7 detected by their portable unit.

8  
9 Indication of altered respiratory effort enables  
10 instant implementation of rescue procedures.

11  
12 Any data recorded during an incident is stored for  
13 analysis for use in, for example, future development  
14 of protective clothing, or improving breathing  
15 apparatus face masks. It is possible to monitor and  
16 record various stress related symptoms felt by fire  
17 fighters operating in thick smoke or in different  
18 types of hazardous zones, and to withdraw a fire  
19 fighter whose stress levels exceed a given point.

20  
21 The data recorded from various sensing transducers  
22 on the fire fighter's person, including heart rate,  
23 respiration, body and face temperature and the like  
24 is of use for analysis to investigate ways of  
25 reducing stress levels. Present technology does not  
26 allow monitoring of fire fighters' reactions when  
27 entering or working in a smoke filled building or  
28 other type of hazardous environment.

29  
30 There is a very limited window of opportunity to  
31 locate trapped or unconscious fire-fighters, since  
32 they have at most less than thirty minutes of air in

1 their cylinder. Presently, attempted location of  
2 such casualties is by means of infra red detectors,  
3 which is slow, and without guidance.

4  
5 With the present invention it is possible to  
6 identify signals transmitted over the radio  
7 telemetry link from the injured or trapped fire  
8 fighter and pinpoint their source, which greatly  
9 reduces the rescue time. The radio telemetry link  
10 has the further advantage of continuous  
11 communication with each fire fighter, which keeps  
12 the controller fully apprised of each fire fighter's  
13 progress, and the state of their wellbeing, with  
14 feedback which is constantly updating.

15  
16 A network of apparatus enables overall control of a  
17 major incident, including monitoring of all vital  
18 data relating to the fire fighters, and the number  
19 of fire fighters operating from each entry control  
20 point.

21  
22 If evacuation is necessary, due to loss of control  
23 over the fire or for any other reason, the apparatus  
24 gives the overall networking controller the facility  
25 to page all fire fighters.

26  
27 The instant a fire fighter is identified as being in  
28 distress, the entry controller is able to contact  
29 the nearest fire fighters to assist in rescuing this  
30 fire fighter, or to direct rescuers to the incident.

1 In essence this invention provides a means to assist  
2 in the management of personnel operating in all  
3 types of high risk zones.

4

5 Data recorded by the control apparatus can be  
6 downloaded by a bar scanner or by means of a  
7 keyboard. This data can include fire fighters' names  
8 ID numbers, times of entry to a danger zone, air  
9 remaining in storage cylinders, and the time it will  
10 take to consume this reserve of air whilst fire  
11 fighting, which is calculated by the apparatus.

12

13 Further embodiments of the invention are provide to  
14 monitor and control use of breathing apparatus for  
15 medical or other purposes.

16

17 Improvements and modifications may be made to the  
18 above without departing from the scope of the  
19 present invention.

20

21

## 1 CLAIMS

2

3 1. A control apparatus for monitoring and  
4 directing at least one person using breathing  
5 apparatus comprising indication means; and  
6 communication means.

7

8 2. A control apparatus as claimed in Claim 1  
9 adapted to receive signals from and/or transmit  
10 signals to remote apparatus associated with  
11 said at least one person.

12

13 3. A control apparatus as claimed in any preceding  
14 claim adapted to communicate with said remote  
15 apparatus by means of telemetry.

16

17 4. A control apparatus as claimed in any preceding  
18 claim comprising an encoder.

19

20 5. A control apparatus as claimed in any preceding  
21 claim comprising programmable visual display  
22 means.

23

24 6. A control apparatus as claimed in any preceding  
25 claim adapted to generate telemetry  
26 identification numbers.

27

28 7. A control apparatus as claimed in any preceding  
29 claim comprising data recording means.

30

31 8. A control apparatus as claimed in any preceding  
32 claim comprising paging means.

- 1     9.   A control apparatus as claimed in any preceding  
2       claim comprising computational means.  
3
- 4     10.  A control apparatus as claimed in any preceding  
5       claim comprising alarm means.  
6
- 7     11.  A control apparatus as claimed in any preceding  
8       claim adapted to co-operate with one or more  
9       control apparatus in accordance with any  
10      preceding claim.  
11
- 12    12.  A control apparatus as claimed in any preceding  
13      claim adapted to co-operate with a remote  
14      apparatus.  
15
- 16    13.  A control apparatus as claimed in any preceding  
17      claim adapted to co-operate with a monitoring  
18      unit and/or distress signal unit.  
19
- 20    14.  A control apparatus as claimed in Claim 13  
21      adapted to monitor information detected by a  
22      sensor or sensors associated with said  
23      monitoring unit.  
24
- 25    15.  A remote apparatus for use with the control  
26      apparatus of any preceding claim adapted to be  
27      associated with at least one sensor.  
28
- 29    16.  A remote apparatus for use with the control  
30      apparatus of any of Claims 1 to 14 adapted to  
31      be associated with respiration and/or pressure  
32      and/or temperature and/or demand valve sensors.

- 1 17. A remote apparatus for use with the control  
2 apparatus of any of Claims 1 to 14 adapted to  
3 comprise an alarm.  
4
- 5 18. A remote apparatus for use with the control  
6 apparatus of any of Claims 1 to 14 comprising  
7 homing means.  
8
- 9 19. A method of monitoring the use of breathing  
10 apparatus comprising the steps of:  
11 generating a job-specific ID number;  
12 allocating the ID number to an individual;  
13 collecting data relating to the well-being of  
14 the individual;  
15 assimilating the data; and  
16 noting whether action is required.  
17
- 18 20. Apparatus as herein before described with  
19 reference to or as shown in the accompanying  
20 drawings.  
21
- 22 21. Method as herein before described with  
23 reference to or as shown in the accompanying  
24 drawings.  
25  
26  
27  
28  
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30  
31



INVESTOR IN PEOPLE

Application No: GB 0112921.2  
 Claims searched: 1-14 & 19-21

Examiner: David Brunt  
 Date of search: 25 February 2002

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): A5T (TED), G1N (NENR), G4N (NAA, NHSX)

Int Cl (Ed.7): A61M (16/00), G08B (21/00)

Other: Online: EPODOC, JAPIO, WPI

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2341686 A (COHEN) see p.1 ll.12-21, p.2 l.17 - p.3 l.5	1-3,5,10-14,19
X	GB 2311015 A (COHEN) see whole document	1-3,10-14,19
X	EP 0801368 A1 (DRAEGER) see col.3 l.47 - col.4 l.23	1,10,13,14,19
X	WO 94/24646 A1 (FIGGIE) see p.6 ll.1-27	1
X	US 5689234 (FULTON) see col.2 ll.48-67	1,5,9,10,13,14,19
X	US 5541579 (KIERNAN) see col.2 ll.12-25	1
X	US 4366821 (KRETSCHMER) see col.1 ll.46-50	1,10,13,14,19

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